

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**IRRIGATION WATER CONVEYANCE  
DITCH AND CANAL LINING, GALVANIZED STEEL  
(Ft.)**

**CODE 428C**

**DEFINITION**

A fixed lining of impervious material installed in an existing or newly constructed irrigation field ditch or irrigation canal or lateral.

**PURPOSE**

- Improve control and management of irrigation water
- Prevent waterlogging of land
- Maintain water quality
- Prevent erosion
- Reduce seepage losses.

**CONDITIONS WHERE PRACTICE APPLIES**

Ditches and canals to be lined shall serve as integral parts of an irrigation water distribution or conveyance system designed to facilitate the conservation use of soil and water resources on a farm or group of farms.

Water supplies and irrigation deliveries for the area served shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Lined ditches and canals shall be located where they are not susceptible to damage from side drainage flooding or they shall be protected from such flooding.

Steel linings shall be installed in well-drained soils or on sites where suitable subgrade drainage facilities are installed before or with the lining, unless the lining is designed to resist the applicable uplift pressures.

**CRITERIA**

**Capacity.** A lined ditch or canal shall have enough capacity to meet its requirement as part of the planned irrigation water distribution or conveyance system without danger of overtopping. Design capacity shall be based upon the following, whichever is greater:

1. The capacity shall be adequate to deliver the volume of water required to meet the peak consumptive use of the crops.
2. The capacity shall be large enough to provide an adequate irrigation stream for all methods of irrigation planned.

For design purposes, the carrying capacity of steel-lined ditches and canals shall be computed by Manning's Formula, using a coefficient of roughness, "*n*", of not less than 0.013.

**Velocity.** A design velocity in excess of 1.7 times the critical velocity shall be restricted to straight reaches that discharge into a section or structure designed to reduce the velocity to less than the critical velocity. The maximum velocity in these straight reaches shall be 15 feet per second (ft/s).

**Freeboard.** The required freeboard varies with the size of the ditch or canal, the velocity of the water, the horizontal and vertical alignment, the amount of storm or waste water that may be intercepted, and the change in the water surface elevation that may occur when any control structure is operating.

The minimum freeboard for any lined ditch or canal shall be 3 inches. If the velocity is within  $\pm$  30 percent (%) of critical, the freeboard shall be at least 6 inches. Additional freeboard shall be

provided as required by slope, velocity, depth of flow, alignment, obstructions, curves and other site conditions.

**Water surface elevations.** All lined ditches and canals shall be designed so that the water surface elevations at field takeout points are high enough to provide the required flow onto the field surface. If ditch checks or other control structures are to provide the necessary head, the backwater effect must be considered in computing freeboard requirements. The required elevation of the water surface above the field surface varies according to the type of takeout or device used and the amount of water to be delivered. A minimum head of 4 inches shall be provided.

**Ditch or canal pad or foundation.** Ditch and canal banks shall be built up with earth to a height sufficient to support the full height of the lining and to provide an anchorage for the top edge of the lining. In cut sections, other than in rock, a berm shall be constructed not less than 2 inches above the top of the lining.

Berms and ditch banks shall be wide enough to prevent excessive deposition in cut sections and to insure support of the lining in fill sections. The minimum width shall be 1 foot. If the bank or berm is to be used as a roadway, the minimum top width shall be adequate for the purpose.

Outside bank slopes and slopes above the berm elevation in cut sections must be flat enough to insure stability.

**Related structures.** Plans for ditch or canal lining installations shall provide for adequate inlets, outlets, turnouts, checks, crossings, and other related structures needed for successful conservation irrigation.

Structures shall be constructed or installed in such a way that the capacity or the freeboard of the ditch is not reduced and the effectiveness of the lining is not impaired.

All structures shall meet applicable NRCS conservation practice standard requirements for the type of structure used.

Bulkheads, formed to fit the lining and of sufficient size to extend at least 12 inches into the earthen ditch pad for the entire width of the ditch lining, shall be installed at the beginning and end of the lining section and at intervening

points, as needed, to provide adequate anchorage.

**Joints.** Joints in steel ditch and canal linings shall be flexible and watertight and provide for contraction-expansion of liner material for the expected temperature variations at the site.

**Materials.** Steel linings installed in soils with high salt or other chemical concentrations injurious to galvanized steel shall be protected with coatings or cathodic protection specifically designed to protect the liner from these chemicals.

Galvanized lining material shall equal or exceed the requirements of ASTM A 525 "General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process." The minimum thickness of the lining material shall be 24 gauge for individual sheets 84 inches or less in width and 22 gauge for wider sheets. The minimum thickness of steel sheets used in bulkheads and related structures shall be 20 gauge.

The edges of the lining sheets shall be rolled or pressed into a shape that will provide added strength at the corners and a firm anchorage into the ditch bank berm at the top of the lining.

Fasteners in the assembly of liners shall be zinc or cadmium plated. Joints shall be filled with sealant material capable of withstanding the temperature variations expected at the site.

## CONSIDERATIONS

Consider the effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, and deep percolation and ground water recharge.

Consider the effects on downstream flows or aquifers that would affect other water uses or users.

Consider the potential for improving irrigation water management.

Consider the potential changes in growth and transpiration of vegetation located next to the conveyance because of the elimination of leakage from the system.

Consider the effects of installing the lining on the erosion of the earth conveyance and the

movement of sediment and soluble and sediment-attached substances carried by water.

Consider the effects on the movement of dissolved substances to ground water.

Consider effects on wetlands or water-related wildlife habitats.

Consider the effects on the visual quality of water resources.

### **PLANS AND SPECIFICATIONS**

Plans and specifications for installing galvanized steel irrigation ditches and canal linings shall describe the requirements for applying the practice to achieve its intended purposes and will include applicable lining cross-sectional shape, grades, material thickness, joints and pertinent structures.

### **OPERATION AND MAINTENANCE**

An operation and maintenance (O&M) plan will be developed for galvanized steel and ditch linings. The plan should document needed actions to ensure that the practice performs adequately throughout its expected life.

O&M requirements shall be determined as part of the design. Any requirements should be documented as brief statements in the plans, the specifications, or conservation plan narrative, or as a separate O&M plan. Typical O&M may include sediment/debris removal, replacement of joint sealant, replacement of deteriorated linings, reshaping berms and weed control as needed.

**APPROVAL AND CERTIFICATION**

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**PRACTICE STANDARD APPROVED:**

\_\_\_\_\_/s/ John Mueller\_\_\_\_\_  
State Conservation Engineer

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04/23/03  
Date